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Ontario Geological Survey
Open File Report 5709

OGS FIELDLOG: A Microcomputer - based Methodology to Store, Process and Display Map - related Data

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Date of Purchase: .....

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ONTARIO GEOLOGICAL SURVEY

Open File Report 5709

OGS FIELDLOG: A Microcomputer-based Methodology to Store, Process and Display Map-Related Data

by

Boyan Brodaric and J.A. Fyon

1989

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V.G. Milne

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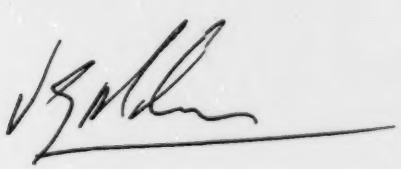
FOREWORD

The rapid changes in modern technology that affect so much of our society are now having dramatic impacts on the geosciences. The development of very powerful microcomputers allows rapid analysis of large, complex data arrays. Improvements in the durability and portability of these computers have now placed them in the field environment. Finally, and perhaps most importantly, sophisticated software designed specifically for, or adapted to, geological applications is being developed to take advantage of the advancements in computer hardware.

One application of this technology to field geology is the storage, manipulation and display of field observations. With the appropriate hardware and software, it is now technically possible for the field geologist to examine and "play with" data quickly in the field. Field maps can be generated, modified, discarded or saved, and particular types of data (eg. structural data) can be manipulated and analysed as they are gathered.

The Precambrian Geology Section of the Ontario Geological Survey has developed a program - FIELDLOG - which links cartographic software with a relational database to allow the geologist to store and analyse data and to expedite the construction of complex geological maps, in both the field and office environments. This Open File Report contains the FIELDLOG program and manual. It is being released now in the anticipation that its use by the geological community will foster discussion and enhancement of this and similar programs.



V.G. Milne

Director

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OGS FIELDLOG: A MICROCOMPUTER-BASED METHODOLOGY TO STORE, PROCESS AND DISPLAY MAP-RELATED DATA

by

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1. INTRODUCTION

Traditional mapping techniques in geology are laborious. A field party takes notes at an outcrop, marks a location on an air photo or some sort of paper map, and moves on. These data are later transcribed to a working copy of the larger map area being examined, and used to develop hypotheses about the geology of the map area. Errors are often introduced during this transcription - outcrops may be misplaced, linear or planar features may be misoriented, and rock types may be miscoded. Many of these errors may be difficult to identify.

The steps in the plotting and revision of the working maps are equally laborious: changes in a working legend as the mapping proceeds require a time-consuming recoding of the

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map face; changes in hypotheses, for example stratigraphic or structural interpretation or the location of contacts, require equally time-consuming erasure and replotting of the working map. They also are accompanied by the possibility of transcription errors. As a last time-consuming step, the final working map must often be completely redrafted as a prelude to publication, again with the possibility of introduction of transcription error.

Modern computer technology now offers the geologist powerful tools to store, analyse, manipulate and display field data. Developments in microcomputers have led to durable, portable machines that can operate on generator or battery power and can endure most of the rigours of the field environment. The storage capacities, analytical abilities and speeds of these machines continue to increase significantly every several years. Commercial software, developed to utilize these computers to their fullest, is equally useful to the geologist. Relational database management programs can store very large amounts of data in a manner that permits easy recovery for any number of purposes, including editing, updating, or entry into other software for such purposes as statistical analysis. Computer-assisted drafting (CAD) programs permit graphic display of data on a computer screen or on paper via a printer. These CAD programs provide the capability of rapid, error-free editing and manipulation of data to show what is required at the scale which is most appropriate.

This manual and the accompanying computer programs (FIELDLOG) are the results of a project to investigate the applications of this computer technology to bedrock mapping programs. FIELDLOG was written to link *AutoCAD*[3], a widely used CAD program, with *dBase*[3], a relational database management program. FIELDLOG allows the geologist to make the fullest use of the potential of these two powerful software applications. It has been developed from a geologist's perspective, to meet the demands of the diverse projects

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3. *AutoCAD* and *dBase* are registered trademarks of Autodesk, Incorporated and Ashton-Tate Company, respectively.

operated by the Precambrian Geology Section of the Ontario Geological Survey. However, FIELDLOG is by no means limited to these projects, but could readily be adapted by an experienced computer user to meet other requirements. Likewise, although FIELDLOG has been developed with *dBase 3+/4*, it could be used with other database management systems whose file structure is compatible with *dBase 3+/4*. However, it must be used with *AutoCAD Release 10*; substitution of a different CAD program is not permissible.

The manual and computer programs contained herein are designed for the experienced computer user. Good knowledge of DOS, previous experience with *AutoCAD* and understanding of the concepts of database management are prerequisites to successful use of FIELDLOG.

FIELDLOG is divided into four main components: (1) the *database definition editor*, for database definition; (2) the *database viewer*, for data exhibition and manipulation; (3) *various housekeeping and output functions*, and (4) *special AutoCAD commands*, for grahics data entry. The operating procedure usually follows this path: databases are created and revised in the database definition editor, data are entered into the databases using the database viewer or the graphics commands in *AutoCAD*, and are manipulated, analysed and prepared for plots or reports using *AutoCAD* or the support functions. Because of the inter-relationships among the different components of FIELDLOG, the initial definition of the databases for each FIELDLOG project is crucial to its success. **It is highly recommended that this manual be read in its entirety before any attempt is made to construct a database and map.** This will ensure familiarity with the various user commands and minimize the chance of creating databases that do not adequately reflect the needs of the project.

FIELDLOG will be modified and expanded with continued development. Its release in this report is intended, in part, to widen its use to explorationists, who will wish to apply it to projects that differ from those of the Ontario Geological Survey. Users are requested to

complete and return the registration form at the front of this report, and are urged to forward suggestions for improvements to FIELDLOG, and comments on its usefulness to:

FIELDLOG
Precambrian Geology Section
Ontario Geological Survey
77 Grenville Street
Toronto, Ontario M7A 1W4

2. INSTALLATION

2.0 Release Files

The release diskette contains six files:

FIELDLOG.EXE	Links *AutoCAD* and *dBase*, performing data and map updating.
FIELDLOG.LSP	An *AutoLISP* program containing supplemental *AutoCAD* commands for the storage and manipulation of map data.
RETRIEVE.EXE	A program which retrieves station information for editing in *AutoCAD*.
GEOSHAPE.SHP	Sample geological symbol descriptions for *AutoCAD*.
GEOSHAPE.SHX	A compiled GEOSHAPE.SHP file containing the sample geological symbols.
FIELDLOG.DBF	A sample project description.

2.1 Hardware Requirements

The system can be used in two modes: (1) *database entry mode*, in which data are entered directly into the databases with the FIELDLOG.EXE program, or (2) *graphics entry mode*, in which data are entered interactively through *AutoCAD* into the databases. The hardware necessary to utilize the system can vary greatly, depending on which of these two modes is used. IBM-compatible microcomputers are mandatory in both modes.

2.1.0 Database Entry Mode

For simple data entry into the databases via the FIELDLOG.EXE program, there are no hardware restrictions. A laptop computer equipped with a hard drive and an 8088 or 80286 microprocessor would be adequate. While this hardware configuration does not lend itself to the efficient use of *AutoCAD*, it has the advantage of portability and can be run on battery power. The data could later be displayed and manipulated on a more powerful, *AutoCAD*-equipped unit.

2.1.1 Graphics entry mode

To run *AutoCAD* and FIELDLOG requires the use of IBM 386/486-based microcomputers or compatibles with at least 2Mb RAM, a math coprocessor, hard drive and small digitizing tablet. An EGA or VGA graphics adapter is strongly recommended, although the Hercules standard will also provide good monochrome screen resolution. The math coprocessor and hard drive are *AutoCAD Release 10* prerequisites, and the extra RAM memory is utilized by FIELDLOG and the extended *AutoLISP* processor. This hardware configuration could be run in the field from a portable or stationary desktop unit, connected to an alternate power source, such as a generator or automobile cigarette lighter.

The hardware requirements of each of these data entry modes are summarized below.

Database Entry Mode	Graphics Entry Mode (*AutoCAD* System)
8088 (80286) microprocessor	30386 microprocessor
8087 (80287) math coprocessor	30387 math coprocessor
hard drive recommended	hard drive (40 Mb)
640K RAM	2 Mb RAM or more
any video adapter	EGA or VGA video adapter
no digitizing tablet required	digitizing tablet

2.2 Software Requirements

FIELDLOG requires two software programs if it is to be fully utilized: (1) *AutoCAD Release 10*, and (2) *dBase 3+/4* compatible database manager.

2.2.0 *AutoCAD Release 10*

AutoCAD Release 10 must be used in conjunction with FIELDLOG to add, view and modify data on the maps. These data are later transferred to the databases. Release 10 is essential to FIELDLOG as it utilizes items called handles which uniquely identify each entity in a drawing, and are used by FIELDLOG to associate map entities with database entries. Handles allow the user to modify map entities and have these modifications reflected in the database.

2.2.1 *dBase 3+/4* Compatible Database Manager

The FIELDLOG.EXE program creates *dBase 3+/4*-compatible databases and permits data to be appended to them. It is also the intermediary between *AutoCAD* and the databases, updating information from the *AutoCAD* maps and allowing data to be retrieved from the databases and viewed or manipulated by the special *AutoLISP* commands. To produce written reports or filtered subsets of the data for processing by other software, any database management software which reads *dBase 3+* files can be used.

2.3 Placement Of Release Files

The release files should be copied into the following directories on the hard drive:

FIELDLOG.EXE and RETRIEVE.EXE should be copied into any directory found in the DOS path specification.

FIELDLOG.LSP, GEOSYM.SHP and GEOSYM.SHX should be copied into the

directory containing *AutoCAD*'s support files.

FIELDLOG.DBF should be placed in an empty directory designated to hold FIELDLOG data.

2.4 Other Files To Modify

In order for FIELDLOG to operate in conjunction with *AutoCAD*, the following lines must be added to the ACAD.PGP file, which is distributed with *AutoCAD*:

DFIELDLOG,C:*pathname*\FIELDLOG.EXE,500000,,4

DRETRIEVE,C:*pathname*\RETRIEVE.EXE,400000,,4

The first line permits access to the FIELDLOG.EXE program from within *AutoCAD*. The second line allows the RETRIEVE command to return outcrop data from the databases to *AutoCAD* for modification. The *pathname* above refers to the directory in which the FIELDLOG.EXE and RETRIEVE.EXE programs are located.

The standard *AutoCAD* menu can also be modified to allow the loading of the FIELDLOG.LSP program from *AutoCAD*'s standard menu system. The ACAD.MNU file, located in the directory containing *AutoCAD*'s support files, must have the following line added exactly as shown and terminated with a carriage return, to permit initiation of the FIELDLOG *AutoLISP* commands from the *AutoCAD* menu system:

[LOG DATA](progn(prompt "Loading...")(load "FIELDLOG"))

This line should be inserted into the first screen menu description of the ACAD.MNU file (see the *AutoCAD* reference manual for more information on modifying screen menus). 'LOG DATA' will then appear in the menu and its selection (using a puck or mouse) will begin loading and initializing the data editing commands which link the *AutoCAD* drawing to the databases. Typing (*load "FIELDLOG"*), including the brackets, at the *AutoCAD*

command line will produce the same results.

2.5 Environment Variables

Both *AutoCAD* and FIELDLOG are dependent on certain DOS environment variables for various memory management configurations and directory specifications. These variables can be initialized by adding the following lines to the AUTOEXEC.BAT file. It is important to set the variables to at least these values:

LISPSTACK=12000

LISPXMEM=,450K

ACADXMEM=,*remainder*K

FIELDDATA=C:*yourdatadirectory*

The ACAD and ACADCFG environment variables should also be set in the AUTOEXEC.BAT batch file, to inform *AutoCAD* of the location of its support and configuration files, respectively:

ACAD=C:*yoursupportdirectory*

ACADCFG=C:*yourconfigurationdirectory*

When single or multiple data directories are maintained, the FIELDDATA variable must be set to the appropriate directory in order to work with its data. This can be accomplished by typing the following at the DOS command line, prior to any work with these data:

FIELDDATA=C:*yourdatadirectory*

With the exception of FIELDDATA, the *AutoCAD* reference manual has more information

on these variables. The FIELDDATA variable controls the directory in which the databases are created and to which data are stored. Separate projects must maintain distinct databases in separate directories, to ensure the storage of data to the appropriate directory. The FIELDDATA variable accomplishes this by informing FIELDLOG of the current working directory, and consequently restricting data manipulation to within the desired project.

The LISPSTACK, LISPXMEM and ACADXMEM variables determine the division between *AutoLISP* memory usage and *AutoCAD*'s I/O space buffer, which is used to buffer drawings. The suggested values were obtained from working with average-sized database definitions and drawings. Reducing the amount of *AutoLISP* stack space with LISPSTACK, or the amount of extended memory (memory above the 1 Mb limit) available to *AutoLISP* with LISPXMEM, can cause several memory shortage error messages in *AutoCAD* (eg. *insufficient string space or insufficient node space*) or simply cause the FIELDLOG *AutoLISP* commands to abort in the midst of execution. The amount of memory required by *AutoLISP* to run the FIELDLOG.LSP commands is largely dependent on the number and complexity of the geological databases. A larger database containing many fields will require a larger memory area dedicated to *AutoLISP* processing, in which case the LISPSTACK and LISPXMEM values should be increased and the ACADXMEM value decreased. However, reducing the ACADXMEM value reduces the space *AutoCAD* uses to buffer the drawing and causes *AutoCAD* to access the hard drive more often during regeneration (*regen*) operations, thus considerably slowing *regen* speeds. A reasonable tradeoff must be determined for each project. The values and formats given for the LISPXMEM and ACADXMEM variables are based on the assumption that the user is not using a portion of the extended memory for a RAM disk. The utilization of a RAM disk will change the declaration of these variables. Refer to the *AutoCAD* reference and installation manuals for the appropriate documentation.

3. PROJECT DEFINITION AND SETUP

3.0 Defining The Project In FIELDLOG.EXE

Before any data can be entered into FIELDLOG, the types of data to be collected must be defined and organized into a logical structure suitable for relational database storage. The data which could be collected at each station should be subdivided into logical groups, which will comprise separate databases. The data belonging to each group will comprise separate fields in each database. These databases represent categories based on how often the datum may be collected at a station. Data collected once per station, such as the date and station number, should be placed in a separate database. All data that may be collected more than once at a station should form databases of intrinsically related data. For instance, the example in Appendix 3 contains STATIon and OUTCRop, ALTERation, COMMOdity, STRUCture, SAMPLe and PHOTO databases. The STATIon database contains data that occur once within the station, and the other databases contain data that may repeat in the station, such as PHOTOgraphs, OUTCRops, SAMPLes or STRUCtural features. Each one of these repeatable databases holds data pertinent only to its classification. For example, the STRUCtural database stores the name of the structural feature (as an *AutoCAD* symbol), a strike or azimuth, a dip or plunge, and the host rock type. As all data belong to a station, the station number is of paramount importance to this organizational method. FIELDLOG refers to it as the ***key field***, and it must be defined in the main, non-repeating database (eg. STATIon). Thus, each project definition for which multiple databases are required must possess a main database which contains, at the very least, a station number field (the ***key field***), and probably also contains other

station-related data.

If it is anticipated that data will be recorded on a one outcrop per station basis, outcrop-specific data such as outcrop location or lithology can also be placed in the main database (STATIon). The example in Appendix 3, however, takes a different approach. It defines a separate OUTCROp database to hold outcrop data, and in this way allows stations to contain more than one outcrop, as outcrop data can be repetitively stored on an as needed basis in the OUTCROp database. It is important to remember that data in other databases (STRUCture, ALTERation, COMMOdity, etc.) belong to the station and not to the outcrop in this definition.

3.1 Tips For Designing Databases In FIELDLOG

In order to avoid making design decisions which might prove damaging later, it is essential that a project be outlined in detail prior to using FIELDLOG. A few trial project definitions and entry of real data should be attempted before settling upon a final design. Note that any design is extremely flexible and may be altered by adding or deleting databases or fields, or by changing field types and widths at any time. However, more drastic changes could prove destructive. For example, deleting the station number and replacing it with a new field would destroy the relational nature of the data in the databases. Another problem involves moving fields from one database to another, a task FIELDLOG cannot currently undertake. To accomplish this, the field to be moved would have to be deleted from one database, and its description re-entered into another database. Superficially there are no problems with this; yet, it is important to realize that deleting a field includes deleting all data stored in it and eliminating any links to *AutoCAD* maps from those data. Valuable data could inadvertently be lost in this process. Users with more database experience might attempt to take a field's data and store them externally, then delete the field and redefine it in a different database, and finally append the

externally stored data into the redefined field. This would only work if data had not been entered through *AutoCAD*, and hence the data would not be linked to a map. But, if data are associated with a particular map, fields cannot be moved in this manner, as FIELDLOG monitors and records the database in which map data reside. The initial deletion of the field would cause FIELDLOG to eliminate all links to the map from that field and cause the map to become inconsistent with the database. Subsequent changes to the map in *AutoCAD* could not be relayed to the database, and the integrity of the database would be compromised.

In designing FIELDLOG for a project, it is also very important to keep in mind the types of output required and the type of work to be done with the accumulated data. It is good practise to quantify and codify data where possible, in order to facilitate the analysis of the data afterwards and to maintain data consistency. Entering the same information in varied form (eg. using CPY, cpy or CpY interchangably for chalcopyrite) could cause searches to extract only portions of the data, and thus skew results and interpretations. Codifying and quantifying data tends to eliminate data entry error and also increase data entry speeds. Quantified data have the added benefit of being more readily available for numeric analysis. Thus, when recording frequencies, densities or magnitudes that are subjective or not easily quantified, it is still a good idea to translate them to a numeric scale and record them as such, leaving open the opportunity for later numeric analysis. Lastly, report output should also be kept in mind when designing the databases, with the use of memo fields encouraged for free-form written notes. Care should be taken that data intended for analysis or for later use in conditional expressions in the search and extraction process are not embedded in memo fields, but rather exist as distinct fields within the database.

3.2 How To Define A Project In FIELDLOG

The user should follow the following steps in designing and creating databases for any project.

1. Determine the types of data required (eg. rock type, alteration type, structural features, commodities).

2. Separate the information into databases which contain data repeated within a station, and one database containing the station number and data which do not repeat within a station.

3. Name each database and each datum entity within each database, and define the name's type (eg. location point, numeric or text, date or memo, or a symbol to be depicted on a map).

4. Type this information into FIELDLOG, filling out the form presented on the screen.

5. Indicate the station identifier called the ***key field*** in FIELDLOG with F5, and indicate the numeric fields used to store the rotation angle of symbols with F6, if applicable.

6. Tag all databases for restructuring, using the F8 key.

7. SAVE the project definition using the F3 key.

Upon completion of these steps, it is possible to input project data from *AutoCAD* or with FIELDLOG.

3.3 Typing The Project Definition Into FIELDLOG

After a project structure has been defined (steps 1 - 3 above), it must be communicated to FIELDLOG (steps 4 - 7 above). At startup, FIELDLOG presents the *database definition editor* - an initial screen showing the current project definition as a sequence of rows. Each row contains 11 columns, and describes one data field in the database. The various fields belonging to a database are also grouped together, row after row, completing a database definition. A series of database definitions completes the project definition. This definition may be revised at any time without consequence, provided some sensible guidelines are followed. Each row contains the following information: DBASE, FIELD NAME, FIELD TYPE, FIELD LENGTH, NO. OF DECIMALS, DEFAULT OPTION, AUTOCAD PROMPT, KEYWORD LIST, AUTOLISP FUNCTION NAME, NULL ENTRY OPTION, MAP DISPLAYABLE OPTION and AUTOCAD LAYER. The top status line contains the FIELDLOG version number and the name of the directory from which data are being presented.

Standard keyboard keys serve the following functions:

Cursor keys:	LEFT, RIGHT, UP and DOWN arrows, PageUp, PageDn, HOME, END
Column edit keys:	ENTER, ESC, INS, DEL, BACKspace, arrow keys
Row edit keys:	INS, DEL

To add a project description, use the cursor keys to move to the desired row and column. The highlight marks the current position, and is moved vertically between rows by the UP and DOWN arrow keys, horizontally between columns by the LEFT and RIGHT arrow keys, and to the beginning and end of each row by the HOME and END keys. The PageUP and PageDn keys move the highlight from one screen of data to the next. Typing any key other than ESC or ENTER will cause the current column to be updated with that

keystroke. In column editing mode, the highlight is turned off and the arrow keys can be used to move within the column, and the INSert, DELete and BACKspace keys can be used to add or remove individual characters. ENTER will begin or end a column update and ESCape will cancel it. ESCape will also end the current FIELDLOG session if pressed at any time other than during column updating. INSert will insert a blank row above the current row and DELete will delete the current row.

Entering a project description into FIELDLOG, therefore, involves inserting blank rows and filling in their column contents, or amending the contents of existing rows.

3.3.0 DATABASE NAME

The database column contains the database name, which cannot be more than five characters in length. The database name can be changed only if the project definition has not been SAVEd since the initial definition of the name. FIELDLOG creates a database for each name during the SAVE process. It is the user's responsibility to verify that all fields belonging to a database are grouped together in successive rows, as FIELDLOG does not check for this. FIELDLOG permits definition of up to 15 databases.

3.3.1 FIELD NAME

The field name is the name of the datum that a field in a database will store, and can be no more than nine characters in length. It can contain any valid *dBase* field name except 'ID', 'IDNO' , 'DWG'. The *key field* name must not be used in any database as a field name, other than the database in which it was originally defined. FIELDLOG does not permit blank or duplicate field names in a database unless they are created in the current session, prior to a SAVE. The SAVE process will ignore any blank field names and they will be eliminated from the project definition. If a duplicate field name is encountered in a database, FIELDLOG will abort the SAVE. Field names can be freely changed, but the

changes will not take effect until a SAVE has occurred. FIELDLOG permits definition of up to 15 fields in a database.

3.3.2 FIELD TYPE

FIELDLOG recognizes seven field types:

DATE	A date, stored as mm/dd/yr and always eight characters long.
INT	An integer numeric value with no decimal digits and a maximum length of 19 digits.
MEMO	A character string consisting of any alphanumeric text. FIELDLOG automatically sets the field length of MEMO fields to 80 characters. However, the MEMO field created in the database will accept up to 32,768 characters for any one entry, irrespective of the value in the LENGTH column. The DECIMALS column is set to 0, NULL to Yes, DISPLAY to No, and KEYWORD and FUNCTION remain blank.
PNT	A numeric REAL or INT value which cannot be displayed on a map. FIELDLOG creates two fields in the database for PNT fields. The names of these two fields in the database correspond to the name of the original PNT field in FIELDLOG, but have an 'x' and 'y' appended. For instance, FIELDLOG would create from a field called 'LOCATION', designated as a PNT field, two fields in the database: 'LOCATIONX', the latitudinal coordinate, and 'LOCATIONY',

the longitudinal coordinate (eg. UTM easting and northing, respectively).

REAL — A numeric value of maximum 19 digits including the decimal point and decimal digits. The number of allowable decimal digits for a REAL must be one less than the specified length of the field to accommodate the decimal point.

SYM — A character string that is displayed on the map as a symbol and which indicates to the database that the field will hold the name of a valid *AutoCAD* symbol. A list of the expected SYMbols must be included in the KEYWORD option of this row. SYMbol names must be from a valid *AutoCAD* symbol file (eg. GEOSYM.SHX). This will avoid data entry spelling errors, keeping the database consistent. More importantly, the data entry routine in *AutoCAD* will abort if a nonexistent symbol name is entered. In database entry mode, the symbol names must also be listed in the KEYWORD column in order to ensure that *AutoCAD* maps can be generated later from the databases.

TEXT — A character string consisting of any alphanumeric text. The maximum length is eighty, with no decimals allowed.

Only TEXT and SYMbol fields are permitted to contain words in the KEYWORD option. Data input to each field is restricted to any one of these KEYWORDs. SYMbol KEYWORDS must be valid names from an *AutoCAD* symbol file. PNT and MEMO field

contents cannot be displayed on a map.

FIELDLOG allows the user to change field types at any time. However, altering field types in a database can result in serious damage to the data in that database. Converting from one text-based field type to another (TEXT, SYM and MEMO) is not problematic, nor is conversion between the various numeric field types (INT, REAL, PNT), as long as some factors are recognized. Converting to a PNT type results in the creation of two fields, *'fieldnameX'* and *'fieldnameY'*, the first of which will retain the original field contents and the second of which will be empty. Conversely, converting from a PNT type means losing the 'y' coordinate in the conversion as the target type (INT or REAL) has room for only one content, the 'x' coordinate. Conversion between text and numeric field types can be harmless provided the contents of the source field match the target field's type, eg. '9999' text to 9999 numeric. However, if the source contents and target type do not match, data will be lost when converting from text to numeric, as non-numeric characters are not copied. The numeric or date to text conversion is safe. Converting from DATE to numeric returns the day of the month as a numeric, and converting to DATE from numeric or text fields not formatted in mm/dd/yr form will produce erratic results.

3.3.3 FIELD LENGTH

The field length value determines the maximum amount of character space allocated in the database for the field's contents. To reserve more space for the field, this value must be increased and the new project definition SAVEd. FIELDLOG will then restructure the database, expanding the size of the field. Numeric fields (INT, REAL and PNT) can be a maximum of 19 characters, and text fields can be a maximum of 80 characters (TEXT, SYM and MEMO). Note that MEMO fields will hold 32,768 characters, irrespective of the value in the field length column. Decreasing the field length and restructuring the databases with SAVE truncates the field contents from the right for both numeric and text

fields.

3.3.4 DECIMAL

The decimal indicator is applicable only to PNT and REAL fields. Other fields must have 0 in this column. The decimal value must be at least one less than the specified field length.

3.3.5 DEFAULT

The default column contains a 'Yes' or 'No' value. If the default is set to 'Yes', the last value entered into this field appears as the default value for the next entry to this field. The default feature operates in both FIELDLOG (database) and *AutoCAD* (graphics) data entry modes. It is useful when dealing with repetitive data (eg. date, air photo number) or data that closely resemble previous entries, because it reduces the amount of typing required.

The following sections (3.3.6 through 3.3.11) supply information meant for *AutoCAD* graphics data entry mode, and can be ignored by those wishing to use only the database data entry mode.

3.3.6 *AutoCAD* Prompt

The prompt column contains the text used by *AutoCAD* to request input to a field. The prompt can contain a maximum of 11 alphanumeric characters. If the prompt column is empty, FIELDLOG will fill it with the field name each time the field name is edited.

3.3.7 KEYWORD

The keyword column contains a list of user-defined codes intended as input values to the field. FIELDLOG restricts the contents of a field to only one of the listed keywords. At least the first letter of each keyword must be capitalized in order to function properly within *AutoCAD*. FIELDLOG is case-sensitive and requires user input to match keywords exactly, so it is advisable to capitalize all keywords. The use of CAPS LOCK and completely capitalized keywords speeds data entry. The KEYWORD facility should be used whenever possible, as it prevents erroneous data from being entered into the database. For example, data such as rock, commodity or alteration type should be encoded and the abbreviations used in the KEYWORD field. SYMbol fields should always contain a list of prospective *AutoCAD* symbol names as keywords. It is safer to begin with a small list and expand it as needed, keeping a close control on the type of data being entered and stored. The KEYWORD column is 15 characters wide but will actually scroll within this area and hold 512 characters, including spaces. It is edited like any other column: type any letter or press ENTER to cause the highlight to disappear and the text to appear as bold characters on the screen. Regular column editing is then possible. To scroll within the column, simply use the RIGHT and LEFT arrow keys.

Defining keywords for a field restricts the contents of the field to one of the defined keywords.

3.3.8 FUNCTION

The function option is only operational in the graphics data entry mode. The function column contains the name of a user-defined *AutoLISP* function that is applied to the entered data. The function treats the entered data as an input parameter and returns a value which is placed in the database as the contents for the field. Data returned to the database from the function must match the input data's type. The function feature can be useful for data checking or performing calculations on field entries. Another application might be the implementation of a data translator, by which abbreviations or codes typed by the user are expanded by the function into their full forms for storage in the database. Note that functions referred to in the FUNCTION column are user-created and require *AutoLISP* knowledge for their construction.

3.3.9 NULL ENTRY

The null entry option is operational only in *AutoCAD* (graphics) data entry mode. It requires a 'Yes' or 'No' response, signifying whether the user is permitted to bypass the field and leave it empty during data entry. The null entry option is generally set to 'Yes', except where data entry is mandatory. For example, the *key field* should always contain a value, and its null entry column must therefore contain 'No'.

3.3.10 DISPLAY ON MAP

The display column indicates to *AutoCAD* whether the contents of a field are stored both to the map and database ('Yes'), or only to the database ('No'). Only essential features should be included in the map, to minimize the size of *AutoCAD*'s drawing file and maintain operation speeds. The creation of specific attribute maps, such as sample location maps, can be accomplished through the attribute map generator, which takes data from the database and translates them into an *AutoCAD* map.

The decision to display or conceal data is an important part of the setup process. To avoid clutter, a minimum amount of data should be placed on the map. At the same time, the map must satisfy all user requirements. Clearly, a thorough assessment of the final product is needed prior to configuring the DISPLAY settings.

Changing the value of the DISPLAY column midway through data entry will only affect data entered after the change. Thus, once data are entered as non-displayable, they cannot appear on a map that is linked to the databases.

It is important to keep clear the distinction between maps linked to a database and maps produced from a database. In the former, changes made to map entities will be reflected in the database; in the latter, they are not. Maps produced from the databases are cartographic products having no association with the databases after their creation from the stored data. These are called attribute maps, and cannot be linked to the databases with this version of FIELDLOG. Subsequent changes to the databases are not reflected in the existing attribute maps, which must be regenerated from the changed databases in order to remain consistent with the stored data.

3.3.11 LAYER

The layer column contains *AutoCAD* layering information for fields that are displayed on the map. The user can enter any valid *AutoCAD* layer name, up to seven characters in length, or the special words 'ECHO', 'TAG' or 'LASTTAG', to specify the map layer onto which the field contents should be placed. The FIELDLOG *AutoCAD* commands will take this information and automatically create new layers, if required, and subsequently add the data to the appropriate layer.

When 'ECHO' is specified, FIELDLOG places the field contents on a map layer of the same name as the field contents. For example, if 'Py' were entered into the MINERAL

field of the commodity database during graphics data entry and its LAYER column was marked 'ECHO', 'Py' would be placed on a 'Py' layer. Likewise, if the next entry into this field were 'Cpy', it would be placed on a 'Cpy' layer on the map.

'TAG' acts similarly to 'ECHO', except that FIELDLOG remembers the name of the current 'TAG'ged layer for future reference by 'LASTTAG'.

'LASTTAG' places the field contents on the last 'TAG'ged layer within a database. For example, if the structural database contained 'FOL' (foliation) in the 'TAG'ged FEATURE field, and a value of 89 in the DIP field marked as 'LASTTAG', the value 89 would be placed on the 'FOL' layer, 'FOL' being the last 'TAG'ed layer within the database.

Generally, it is good practise to separate data into as many layers as possible. A highly layered map permits very flexible data differentiation, as any combination of layers can be viewed on screen and exported to various output devices. As *AutoCAD* places no limits on the number of layers in a drawing, as many layers as possible should be created. 'ECHO', 'TAG' and 'LASTTAG' are especially useful in this respect, as they create layers at the lowest possible level - the actual value of the entity being placed on the map. For example, each MINERAL in the COMMOdity database would be placed on its own layer (eg. Py on a Py layer) with the inclusion of 'ECHO' or 'TAG' in the layer column. Individual MINERALs or any combination of MINERALs could then be displayed on the screen and also outputted to a plotting device, to quickly prepare MINERAL distribution maps.

4. FIELDLOG OPERATION

4.0 General Operation

Three of FIELDLOG's main components - the *database definition editor*, the *database viewer* and *various housekeeping and output functions* - are located within FIELDLOG.EXE. Each component makes use of special keys (eg. F1 through F10, ESC, and cursor keys). The database viewer, which is used to display and manipulate data, is resident within the database definition editor. The operating procedure usually follows this path: databases are created and revised in the database definition editor, data are entered into the databases with a combination of *AutoCAD* graphic entry and database entry modes using the database viewer, and plots or files are generated for reports. When FIELDLOG is started, the user is presented with the database definition editor, containing the current database definitions. These are listed in tabular format, with each row defining one field in a database. Each row contains columns for information on individual fields, and a grouping of such rows defines the component fields of a database. Initially, the sample database definitions will be displayed, but these can be amended to suit the user's needs. (A sample listing of database definitions is given in Appendix 3.) A status line above the database definition editor contains FIELDLOG's current version number and the directory from which data are being displayed. A list of the available function keys is given along the bottom of the screen, in both the database definition editor and the database viewer. The database viewer is initiated within the database definition editor by pressing F7.

4.1 Database Definition Editor

The following sections describe the operation of special keys in the database definition editor.

4.1.0 ESCape

All operations in FIELDLOG, within both the database definition editor and the database viewer, can be cancelled with the ESCape key, including:

Exiting the database viewer to the database definition editor.

Cancelling all prompts appearing in a query window. Pressing the ESC key in response to a window question is equal to replying 'No', or negating the action. Window queries, such as 'Exit ?', 'Save ?' and various selection windows in the attribute map generator, are cancelled with ESC.

Clearing error messages.

4.1.1 F1 - Help

F1 displays a list of keys available to the user during an operation in FIELDLOG, and their functions. The ESC key must be used to clear the HELP window.

4.1.2 INSert

INSert adds a blank row directly above the current row. Fields are added to the database by INSerting new rows and supplying information to their columns. A new row is also added to the definition if the user moves the cursor below the last defined field. The database is expanded to contain new fields during the restructuring portion of the SAVE process.

4.1.3 DELete

DELete removes the current row from the database descriptions. FIELDLOG will confirm the DELetion of rows containing data in the corresponding field of the database. It is important to note that DELeting a row removes that field and all its data from the database during restructuring in the next SAVE.

4.1.4 F2 - UPDATE

Pressing F2 while in the database definition editor updates the database with additions or modifications made to the map during editing in the graphics entry mode. The changes to the map are saved to text files located in the data directory. FIELDLOG must process these changes with F2 to update the databases and make them consistent with the map. Data to be appended to each database are located in a text file named after the database and having a '.DAT' file extension (eg. STRUC.DAT). Modifications, such as deletions, rotations and hidden data, are recorded in a separate file called 'MOD.DAT'. In the update process, FIELDLOG first appends data from '.DAT' files and then performs modifications to the data from the 'MOD.DAT' file. FIELDLOG displays a flashing UPDATing message at the top of the screen during updating. UPDATE is valid only for changes made in graphics data entry mode; it serves absolutely no purpose in database entry mode. An UPDATE should be performed immediately after data have been entered in the graphics mode.

4.1.5 F3 - SAVE

Pressing the F3 key will save the current database definitions, UPDATE any outstanding data and restructure the databases to match any new definitions. If no changes were made to the database definitions, SAVE will simply record the definitions, but will not restructure the databases unless instructed to do so by pressing the F8 key. The SAVE process will

abort if duplicate field names are found in a database, or if no *key field* has been set. SAVE eliminates rows that contain empty database name, field name or field type columns.

Restructuring is usually unnecessary unless changes have been made to the database definitions. One reason to restructure a database is to eliminate deleted records from that database. Note that marking a row for deletion will not cause the database to be restructured during a SAVE. Databases will be restructured with SAVE only if they have been tagged with F8, or if their field definitions have been changed. To restructure databases whose definitions have not been changed, F8 must be pressed and the desired database tagged for restructuring with the ENTER key. Pressing F2 then SAVEs and restructures the tagged databases.

Databases created by FIELDLOG during restructuring contain the fields defined in FIELDLOG for a database, and two additional fields: the *key field* and a field called ID. If the *key field* is defined in a database, this database contains only the one extra ID field. **The ID field contains system-specific information and must not be changed.** The ID field is not displayed by FIELDLOG in the database definition editor and should not be tampered with.

4.1.6 F5 - Key Field

The *key field* is the row in FIELDLOG's database definition editor that describes the station number. The F5 key is used to designate the *key field* to FIELDLOG. If no *key field* exists, pressing F5 will cause an asterisk to appear in the far left column of the row, and that field will become the *key field*. Pressing F5 while the cursor is on the *key field* row will remove the *key field* designation from that row.

A project in FIELDLOG can have only one *key field*. However, FIELDLOG requires that every database defined for a project has a *key field*. If one is not present, FIELDLOG

will refuse to SAVE the definition. Once a *key field* is selected, that field's definition cannot be altered until the *key field* designation is removed from it. To change the contents of a column within the *key field* row (eg. change the field length), the *key field* designator must first be removed from that row by pressing F5, then the change made, and finally the *key field* designation restored. **The *key field*'s name must not be changed once data have been entered, or all previous *key field* contents will be lost.**

The *key field* is normally a row in the database of data that occur only once at a station. FIELDLOG refers to this row in the SAVE process and creates a field corresponding to that row's description in all the databases. In this way, every record in a database will contain space for its fields and also contain room for *key field* values. Thus, the *key field* is common to all the databases, and data in different databases are related through the contents of the *key field*. For example, in the sample project definition given in Appendix 3, STATIONNO in the STATIon database is the *key field* and would appear in every database created by FIELDLOG. Thus, when entering data, the station at which the data occur must be recorded along with the data. A typical entry into the STRUCtural database might contain a rock type, the structural feature, strike/azimuth and dip/trend readings and the station number.

The *key field* must be chosen prior to any data entry, and it must not be changed after data have been entered into the databases. If a different *key field* is chosen midway through data entry and this setup SAVEd, the previous *key field* values in all the databases, except the original *key field*'s, would be deleted. All the common data would be destroyed and the databases would become unrelated. The user would then have to enter the new *key field* values into each record in each of the databases, to restore the common data and the relational structure of the databases.

4.1.7 F6 - Rotation Angle

F6 selects the field containing the angle at which an item indicated in the SYMbol field is rotated (eg. the STRIKE field in the STRUCtural database). The angle field must be a numeric value (INT or REAL) and the field that is to be rotated at this angle must be of SYMbol type. This information serves two purposes: it relays to *AutoCAD* during graphics data entry that the rotation angle of a symbol must be stored in a particular field, and secondly, it is used by the attribute map generator to generate a symbol at the correct angle.

To establish a symbol-rotation angle relationship between two fields, place the highlight on any column in a SYMbol field and press F6. A small diamond will appear in the leftmost column of that row. Next, move to the row defining the rotation angle field and press F6 again. FIELDLOG will respond with a message confirming the selection of a rotation angle for a SYMbol. To remove this relationship, move the highlight to the SYMbol row displaying the diamond, and press F6. The diamond will disappear and the relationship will be terminated.

The geological convention of the right hand rule has been used in the definition of the rotation angle in FIELDLOG.

4.1.8 F7 - Access To The Database Viewer

F7 accesses the database viewer, which allows databases to be viewed and modified by the addition, deletion or change of data. The operation of the database viewer is described in Section 4.2.

4.1.9 F8 - Database Restructuring

F8 is used to tag databases for restructuring. Pressing F8 causes a database list to appear

in a selection window, and the databases can be tagged or untagged with the ENTER key.

To tag a database, use the cursor keys to move to the database and press ENTER. An asterisk will appear to the right of the selected database. To untag databases, move the highlight to the tagged database and press ENTER again. The database will be untagged, and the asterisk on the right will disappear. Databases can only be untagged during the selection session in which they were tagged. The tagging process is irreversible: if a database has been tagged and ESC has been pressed to end the selection, the tagged database cannot be untagged. Pressing ESC ends the tagging process.

Databases require restructuring if a field definition has been changed, or if a database contains deleted records that should be purged. When field definitions have been altered, FIELDLOG automatically marks the changed database for restructuring during SAVE. To purge deleted records from the databases, the user must use F8 to tag the databases and SAVE to restructure the databases.

4.1.10 F9 - Generation Of Attribute Maps And Text

Pressing F9 allows the user to perform a conditional search on the databases and to display the results in an *AutoCAD* drawing file or ASCII text file. The user specifies the database to be searched, and places conditions on the fields of the database. The conditions can include the restriction of data to a rectangular area, as well as the application of conditional operators, such as >, <, and =. FIELDLOG scans the database for data meeting these conditions and pauses at each successful occurrence to output the data in a manner specified by the user. The data can be displayed in an *AutoCAD* drawing file, with each occurrence depicted as a symbol or text (eg. a box or 'Cpy'), or the actual contents of fields at each occurrence can be plotted to an *AutoCAD* drawing file or listed in a text file. In order for FIELDLOG to plot the data, the user must also specify the database in which station locations are stored. When an occurrence is found,

FIELDLOG notes its station number, locates the first occurrence of this station in the database containing the station coordinates, and plots the specified fields at this one station location or prints the contents of the fields to a text file. When many data meet the search conditions at a single station, FIELDLOG overlays each datum at that one location.

Once generated, these maps have no ties to the databases. They are simply *AutoCAD* drawings, which may be inserted into other drawings or displayed on their own as stand-alone maps. Any changes made to these drawings are not reflected in the databases, and any changes to the databases are not passed onto the drawing. Once a drawing is generated with F9, it is completely divorced from the database.

The text files created with the output generator (F9) contain lines of data that meet the user-defined conditions. Each line contains the contents of the fields to be outputted at an occurrence, separated by a space. The text file forms a table of data, in which successive rows represent different occurrences and each column within a row contains the contents of the chosen fields. This feature can be used as a simple method of report generation or data export. More comprehensive report generation and data extraction can be carried out by a database management package.

4.1.10.1 Output Generation

Pressing F9 displays a list of databases. The database to be searched is selected by pressing ENTER, and FIELDLOG responds with a list of fields, from which a search condition is created. The search condition consists of a series of conditional expressions logically joined with 'and' (eg. expression 1 and expression 2 and expression 3). Each expression contains a field, a relational operator, and a value that the field must satisfy (eg. MINERAL = Py and ROCKTYPE = BASALT, in the COMMOdity database). These expressions are built from the repetition of three selection windows which prompt for the field to search, the relational operator to be applied to this field, and the

corresponding value. Pressing ESC at the field and operator windows will end condition building, and pressing ESC at the value prompt will cause the field selection window to appear. If ESC is pressed at the field or operator selection windows and no expression has previously been created, the output generator exits to the database definition editor.

The following relational operators are available in the construction of search conditions:

>	*greater than*
<	*less than*
>=	*greater than* or *equal to*
<=	*less than* or *equal to*
#	*not equal to*
=	*equal to*
containing	
not containing.	

The = operator requires the field contents to exactly equal the given value. *Containing* and *not containing* are applicable only to text fields (MEMO, SYMbol, TEXT). They determine whether the given value is found or not found in whole or part within the given field (eg. FRAC is contained in IFRAC and VFRAC). The operators >, <, >=, <=, #, and = can be used with all field types.

Once a valid condition is created, FIELDLOG queries the user for the database containing the station location and its x-y coordinate fields within that database. Only a PNT (point) field can be chosen as an x or y coordinate. If a database is chosen which does not possess a PNT field, FIELDLOG will exit the output generator and return to the database definition editor. Pressing ENTER makes a selection in the database and field windows, and pressing ESC ends output generation.

After conditions have been set and location fields chosen, FIELDLOG asks for the type of output required. Data meeting the search conditions can be plotted for each occurrence as an *AutoCAD* symbol, a text string, or the actual contents of various fields.

When either the *AutoCAD* symbol or text string option is chosen, FIELDLOG always creates an *AutoCAD* drawing file. The field contents option can create either *AutoCAD* plots or text files. With the symbol or text string option, occurrences of the specified symbol or text are placed at stations meeting the given conditions. For example, triangles or 'Py' can be plotted at each occurrence of the condition: 'Py' in the MINERAL field and 'BASALT' in the ROCKTYPE field, of the COMMOdity database. The font file 'TXT.SHX' is used as the default font for *AutoCAD* drawings created with FIELDLOG. If occurrences are displayed as symbols, FIELDLOG will prompt for the name of a valid *AutoCAD* symbol file, and then for the name of the symbol to plot. If the symbol is not present in the symbol file, FIELDLOG will reply with an error message and ask the user to try again. Entering a valid symbol name will cause FIELDLOG to query for the angle to which the symbol is to be rotated. Pressing ESC will exit the output generator at any of these queries.

When field contents are chosen, FIELDLOG permits the output of several fields' contents. FIELDLOG will display a selection window containing database fields and will allow the selection of fields until ESC is pressed. The fields are outputted in the order of their selection at each occurrence. If a SYMbol field is chosen, FIELDLOG will request the name of an *AutoCAD* symbol file.

FIELDLOG permits the search to occur within a rectangular area by prompting for bounding coordinates. Pressing the ENTER key moves the cursor from one coordinate to the next, and pressing ESC ends selection. If no boundaries are given, FIELDLOG will search the entire database.

If field contents are to be plotted, FIELDLOG will next prompt for selection of *AutoCAD* or text file output.

Finally, FIELDLOG asks for the output file name before beginning the search. An *AutoCAD* file must end with '.DWG'. Text files can be any valid DOS file name.

During output generation, FIELDLOG informs the user of the number of occurrences identified in the search. This information is displayed at the top of the screen.

4.2 Database Viewer

The following sections describe the operation of special keys within the database viewer.

4.2.0 F7 - The Database Viewer

F7 initiates the database viewer from the database definition editor. This allows databases to be viewed and modified by the addition, deletion or change of data. Pressing F7 causes FIELDLOG to display a database selection window. The cursor keys are used to move the highlight to a database name and ENTER selects that database for viewing. FIELDLOG displays the databases in table format, with individual fields placed left to right on a single line, and with each line representing one record in the database. FIELDLOG presents only the number of fields that fit on the screen at any one time. The cursor keys can be used to scroll horizontally along a row, in order to display any remaining fields. The available function keys are listed along the bottom and a status line appears along the top. The station number is always the first field in a row, except possibly in the database in which it was defined. New, blank records can be created with the INSert key and existing rows can be tagged for deletion with DELete. Data can be entered into

Fields representing map data should not be edited in this way. For data appearing on a map, use the graphics editing mode in *AutoCAD* to make the changes, and then UPDATE them in FIELDLOG. This ensures that the changes are also effected in the database. If the graphics entry mode is not being used, then all data can be freely changed. FIELDLOG assumes data have been entered with the graphics mode and disallows entry into fields set for display on the map. Pressing F10 eliminates this restriction and permits editing of these fields. If keywords have been defined for a field, FIELDLOG will limit data entry to those keywords. The list of permissible keywords is displayed in a window at the top of the database viewer and can be scrolled one line at a time by pressing F6. Pressing F9 allows the user to find a specific station or record number, or move to the top or bottom of the database. Various cursor key combinations will also reposition the highlight within the database (eg. Cntl-PgDn moves to the bottom of the database and Cntl-END moves to the last field in a row).

4.2.1 Movement Keys

The following keys can be used to move within a database:

Up arrow	Up one row.
Down arrow	Down one row.
Left arrow	Left one field.
Right arrow	Right one field.
Cntl-Left arrow	Pan left one field.
Cntl-Right arrow	Pan right one field.
Home	Leftmost field on the screen.
End	Rightmost field on the screen.
Cntl-Home	Leftmost field in a row.
Cntl-End	Rightmost field in a row.

PgUp	Previous screen.
PgDn	Next screen.
Cntl-PgDn	Topmost row in the database.
Cntl-PgUp	Bottommost row in the database.

4.2.2 Status Line

In the database viewer, FIELDLOG displays a status line at the top of the screen, consisting of the database name, the record number of the current row, and the deleted and the hidden status indicators. Rows can be marked and unmarked for deletion with the DELete key, and purged during database restructuring. If a row is deleted, the status line will say 'Deleted' in the third status column. It is important to note that 'Deleted' refers to the entire row, whereas the 'Hidden' indicator refers only to specific fields. When a field is denoted as 'Hidden' (in the fourth status column), the data in the field do not appear on the map, but are retained in the database. If the field is empty or its DISPLAY setting is 'N' (it does not appear on the map), the hidden status column will remain empty. **Once a field's contents are hidden they cannot be restored to the map.**

4.2.3 ESC - Exit Database Viewer

Pressing ESC exits the database viewer and returns the user to the database definition editor. If the user is performing functions within the database viewer (eg. field editing or moving around the database) pressing ESC once will cancel the current operation. To exit the database viewer, ESC must be pressed a second time, after the cancellation of the function.

4.2.4 F1 - Help

Pressing F1 in the database viewer displays a list of keys and their functions, available to the user during database viewing and field editing. The ESC key must be used to clear the HELP window.

4.2.5 F6 - Choices Window

The choices window, located immediately below the status line, lists the keywords permitted as entries to the highlighted field. The keywords are defined in the KEYWORD column of that field, in the database definition editor. If there are many keywords available to a field, the keyword window displays only one line of the possibilities, and the user must use F6 and the arrow keys to scroll through the remaining keywords. To add more keywords to the list, the KEYWORD column for that field must be modified in the database defnition editor and the database definition SAVEd. The database viewer will then contain the updated keyword list. **Defining keywords for a field restricts the contents of the field to one of the defined keywords.** ESC exits the choices window.

4.2.6 F7 - Database Selection

Pressing F7 while in the database viewer displays the database selection window, and permits selection of a database by pressing ENTER. The selected database will be displayed for viewing and editing. This selection can be cancelled by pressing ESC.

4.2.7 F9 - Moving In A Database

Pressing F9 repositions the highlight in the database. When F9 is pressed, the user is presented with a selection window offering the following options: move to the top or bottom of the database, or move to a specific record number or station number.

FIELDLOG prompts for the record or station number if the latter option is selected. If the requested station or record number is not found, FIELDLOG replies with an error message and the position of the highlight remains unchanged. If the record or station number is found, the highlight is repositioned in the same column of the appropriate row.

4.2.8 F10 - Edit Map Data

Pressing F10 allows the user to edit data which appear in both the database and a linked *AutoCAD* drawing. F10 is in the off position at the start of each FIELDLOG session, disabling any editing of DISPLAYable fields. Pressing F10 will enable the editing of these fields and inform the user of this status in a window message. Pressing F10 again will disable DISPLAYable field editing. **Fields containing map data should not be changed in the database,** but should be modified in *AutoCAD* using FIELDLOG's editing commands. The user must use *AutoCAD*'s enhanced commands to make such changes and to maintain map-database consistency. There is one exception to this: hidden map data can be changed in the databases, as these data have already been permanently removed from the map. Non-map data can be edited at all times, irrespective of F10's status.

4.2.9 INSert New Record

INSert adds new data to the database by appending a blank row to the database. The row contains empty entries for each field in the database. FIELDLOG displays data in ascending station number order; therefore, new rows are placed at the top of the database, since they contain empty station numbers. When the DEFAULT option is activated for a field, FIELDLOG will remember the last entry to this field and use it as a default in the next INSert. For example, if 9999 were the last entry into the STATIONNO field of the STATIon database, then the next INSert would place 9999 in the STATIONNO field of the new row. Because the data are ordered on the STATIONNO field, which contains

9999 in the new row, this new row would be placed directly below the row with an existing 9999 station number, and not at the top of the database. Thus, the insertion of new rows at the top of the database can be avoided by allowing the *key field* (eg. station number) to default to the previous entry. A dangerous aspect of this method is the increased possibility of error in station number entry, as it is easy to forget to amend the default station number.

4.2.10 DELete - Tag Current Record For Deletion

Pressing the DELete key in any column of any row, with the highlight present and no field being edited, will cause that row to be tagged for deletion. The third column of the status line will contain 'Deleted' to reflect this status. Pressing DELete again will untag the row and clear the status line of the 'Deleted' indicator. The databases are purged of deleted rows only during the SAVE and restructuring procedure, and only if that database has been tagged for restructuring. **Deleting rows containing data present in a map will not eliminate this data from the map.** It is important not to delete map-resident data, in order to keep the maps and databases congruent.

5. *AUTOCAD* INTERFACE

5.0 Graphics Data Entry Mode

This section contains descriptions of customized *AutoCAD* commands and guidelines for the interactive use of *AutoCAD* with FIELDLOG. This method of data entry (graphics mode) allows data to be manipulated graphically and resembles standard cartographic map-making. Data are entered with the special commands, which place the data on the map and save them to text files and eventually to the databases. In this way, the map and databases are constructed simultaneously.

5.1 FIELDLOG And *AutoCAD*

To use FIELDLOG interactively with AutoCAD, the databases must first be defined and SAVEd with FIELDLOG.EXE. This provides the FIELDLOG AutoCAD commands with information relevant to the specific project and prepares them for immediate data entry. The FIELDLOG AutoCAD commands interact with AutoCAD through AutoCAD's internal programming language, AutoLISP. The FIELDLOG commands make extensive use of AutoLISP and require installation of the extended memory LISP processor EXTLISP prior to each start of AutoCAD. This installation can be initiated by typing EXTLISP at the DOS command line, immediately prior to beginning AutoCAD. AutoCAD can be started by typing ACAD at the DOS prompt.

To add data to a drawing or to modify existing data, the drawing must be brought up in *AutoCAD*'s drawing editor and the 'LOG DATA' menu item selected with a mouse or

puck. Alternatively, *(load "fieldlog")* can be typed, including the brackets, at *AutoCAD*'s command line to initiate FIELDLOG's *AutoCAD* commands. These commands should be used only with data that are to be included in the databases, as each command leaves a record of usage which is later processed by FIELDLOG and applied to the databases. To add data to the map but not to the databases, use *AutoCAD*'s many cartographic commands. AutoCAD's inherent commands are not tied to the databases in any way whatsoever and simply modify the existing drawing, whereas FIELDLOG's AutoCAD commands manipulate both drawing and databases. An example of this is the distinction between adding outcrop outlines or station location symbols to a map, and adding actual station data to the map. The outcrop outline is simply a line (drawn using AutoCAD's PLINE) that defines the boundary of the outcrop. It is of no relevance to the database, other than as a basis for choosing the station location when prompted by the ADD command during addition of data to the STATIon database. Crosses or triangles can be used, instead of boundary lines, to designate station locations, and they are added with AutoCAD's SHAPE command. Again, they have no bearing on the databases, except as reference points for station location prompts in the STATIon database.

Entities to be added to the map only, and not to the databases, should be added using standard *AutoCAD* commands. Data to be revised or appended to the databases must be processed with FIELDLOG's *AutoLISP* commands.

5.1.0 FIELDLOG And HANDLES

It is mandatory that the *AutoCAD* HANDLES feature be turned ON before any data entry is carried out. The FIELDLOG commands and database links make extensive use of the handles, and they must be present in the drawing before any of the FIELDLOG commands will function. Refer to the *AutoCAD* reference manual for more information on HANDLES. Under no circumstances should handles be destroyed in a drawing, as this

will eliminate all database links and disconnect the *AutoCAD* drawing from the databases. A project in FIELDLOG consists of databases and possibly linked *AutoCAD* drawing files. If data are entered using *AutoCAD* (ie. in graphics entry mode), FIELDLOG passes the data and the associated *AutoCAD* links to the databases in ASCII files. The *AutoCAD* HANDLES feature must be ON to generate these links.

5.1.1 FLATLAND System Variable

A useful feature that decreases the size of the *AutoCAD* drawing file and results in improved *AutoCAD* performance is the *AutoCAD* FLATLAND system variable. Initializing FLATLAND informs *AutoCAD* that the drawing is to be saved by storing only two dimensions, considerably reducing the file size and its effect on loading and regeneration speeds. As surface geological mapping deals with only two dimensions and FIELDLOG records only x and y coordinates, it is pointless to store the third dimension in the drawing file. When *AutoCAD* is operating, it assumes a third coordinate uniformly set to 0, enabling the user to use the third dimension in the drawing editor even with FLATLANDed drawings. In this way, the user suffers no loss in functionality by initiating FLATLAND. For more information on FLATLAND, see the *AutoCAD* reference manual.

A curious, undocumented phenomenon occurs with FLATLAND when it is first set. It seems to require that the user enter and leave the drawing twice after its initialization, before the drawing file is properly reduced in size. When a drawing is first loaded after it has been FLATLANDed and saved with END, it does so as if FLATLAND had not been set. ENDing and re-entering the same drawing a second time, and forever afterwards, causes it to load and react with FLATLAND in effect, as expected.

5.1.2 *AutoCAD* System Variables Used By FIELDLOG

FIELDLOG uses the following *AutoCAD* user system variables: USERI1, USERR2, and USERR3. USERI1 stores a unique drawing number for the current map and should never be tampered with. USERR1 and USERR2 store the current symbol and text sizes, respectively. These sizes are set with SIZE (Section 5.3.6) and there is no need to reference them in any other manner.

5.2 Digitizing Outcrops From An Air Photo Or Map

Outcrop boundaries and station locations should be digitized onto the map, before beginning data entry. This gives the user an estimate of data density, and of the data's relative spatial positioning. To digitize from an air photo or map, secure the air photo or map to the digitizing tablet and zoom in on approximately the area desired for the *AutoCAD* drawing. If the paper map is at a larger scale than the final digital map or contains known areas of distortion, calibrate only small areas at a time, in order to align the two properly. This same procedure should be followed in the case of an inaccurate digital base map. Use the TABLET CALIBRATE command to align digital and paper maps, by first choosing a prominent point on the paper map and then the same point on the digital map. Repeat the procedure for a second point to complete calibration. The digital and paper maps should now be aligned. Once this calibration has been completed, outcrop boundaries and station locations can be traced directly from the paper (or mylar) map. Use *AutoCAD*'s PLINE or SKETCH commands to trace the boundaries, keeping the line segments as long as possible. Since the final output scale will probably differ for the input scale, making line segments as long as possible ensures that what appears rough or rectangular at the input scale will be smoother and more aesthetically pleasing at the final, larger scale. As well, dashed linetypes have a tendency to become continuous if the line segments are too small. If necessary, station locations can also be digitized using the

SHAPE command, by transferring the site of the location symbol directly from the paper map. When adding symbols to the digital map, it is important to determine an appropriate size prior to much digitization, as sizing will affect symbol placement around the station, and hence affect the data density and visibility of the symbols at the final output scale. It is important to know the final output scale at data input time. Plot some test data at this predetermined scale to ensure that symbol and text data are visible and properly sized. The FIELDLOG SIZE command (Section 5.3.6) can be used to adjust symbol and text sizes.

5.3 Fieldlog *AutoLISP* Commands

Symbol and text sizes should be determined using test data at the final output scale and with the expected data density. SIZE (Section 5.3.6) can be used to adjust these sizes. Increasing or decreasing symbol or text sizes after significant amounts of data have been entered is very laborious, since the relative positions of the text and symbols are unaffected by the change in size. This can cause the data to overlap or to be too sparsely spaced, which would require each datum to be individually moved into place with *AutoCAD*'s MOVE command.

Data are added to the map with ADD, edited with MODIFY, ERASE, ROTATE, HIDEDATA or RETRIEVE, and saved with STORE. The FIELDLOG command accesses the FIELDLOG program for data viewing and database redefinition.

Note that *AutoCAD*'s UNDO feature will not undo changes made with FIELDLOG's editing commands.

Prior to beginning data entry, FIELDLOG's *AutoLISP* commands must be initiated by picking 'LOG DATA' from the main menu or typing *(load 'fieldlog')*, including brackets, at *AutoCAD*'s command prompt. The commands will begin loading from the FIELDLOG.LSP

file, and the user will then be prompted, as follows, for the directory in which to store data:

Data directory [C:*datadirectoryname*]: _

The data directory is specified at the DOS command line with the FIELDDATA environment variable (eg FIELDDATA=C:*datadirectoryname*). The FIELDLOG commands display this directory in square brackets as the default during loading. The user can specify an alternative directory, or press ENTER to accept the default. FIELDLOG will not accept an invalid data directory, and will redisplay the directory prompt until a valid directory is chosen. If the user uses Cntl-C to abort this procedure before a valid directory has been selected, FIELDLOG's commands will refuse to function afterwards and will give the following error message:

No data directory chosen. Reload program for the data directory.

If a valid data directory is selected, the commands will resume loading. Upon completion, the message 'Loaded' is displayed, *AutoCAD*'s command prompt reappears, and the FIELDLOG commands are ready for use. The commands ERASE, ROTATE, QUIT, SAVE and END replace existing *AutoCAD* commands, and are available for use from the standard menu system. **The ERASE command should not be started from the pull-down menu**, as it interacts erratically with *AutoCAD*'s command line when invoked this way.

5.3.0 Add

ADD appends data to the drawing and writes the data to text files for later updating with FIELDLOG. ADD automatically places data for each field on the appropriate layer, as specified in the LAYER column of the field's definition in FIELDLOG.

ADD first asks the user if the data are to be added to an existing station, by displaying

the following prompt:

ADD TO EXISTING Station No: [ ] ( ) _

If this is not the case, this query can be bypassed by pressing ENTER. ADD then queries for the database that will receive the data and presents a list of available database names. The following example lists the databases included Appendix 3:

Add to database: (STATI OUTCR STRUC COMMO ALTER PHOTO SAMPLE) _

If a new station is being added, the list contains all the defined database names. If data are being added to an existing station, the database containing the *key field* (eg. STATIon) is not included in the list.

To create a new station, the database containing the *key field* (eg. STATIon) must be filled before a station's data are entered into any other database. Once the *key field*'s database (cf. STATIon) has been filled, any of the remaining databases can be accessed as often as required. For example, in order to record three structural measurements at a station, three individual accesses to the STRUCtural database would be necessary for that station.

ADD scrolls through the fields in each database and prompts the user for data at each field. If the NULL setting is active, users can press ENTER and leave the field blank. Otherwise, with NULL inactive, data must be entered in response to the prompt. Data must satisfy field type and length requirements or FIELDLOG will generate an error message and repeat the prompt. ADD allows at most 80 characters to be inputted into a MEMO field. FIELDLOG's word processor-like memo editing can be used to add more text to MEMO fields.

Each data entry prompt may contain a default entry and a list of restricted keywords. If the default option is activated for a field, then the last entry typed into this field will become the next default value. Default values are listed in square brackets following the

prompt text, as:

Rock Type: [BASALT] ( ) _

When defaulting is activated for a field and ENTER is pressed, the NULL option is ignored and FIELDLOG stores the default value into the field. A list of keywords may also be present, enclosed by round brackets ( ), following the default value. Keywords represent the list of permissible entries for a field, as for example:

Rock Type: [BASALT] (BASALT DACITE ANDESITE) _

ADD will refuse to accept an entry that is not in the list.

Fields defined as DISPLAYable in FIELDLOG will be placed on the map immediately after the user's response to the data entry prompt. FIELDLOG asks the user to specify a location and rotation angle for the text or symbol to be added. The user can reply with the appropriate location using the puck, mouse or keyboard, or they can type 'h' or 'hide', indicating that the datum is to be recorded for storage in the database only and is not to be displayed on the map. A numeric value can be entered in response to the rotation angle prompt, or the user can visually determine the angle with the puck or mouse. Drawing entities are oriented such that 0° coincides with vertical and angles increase in a clockwise direction (ie., the right hand rule convention). This results in horizontal text entries being placed at an angle of 90° . The default rotation angle for text is 90°; for symbols, the default angle is 0°. This command sequence thus resembles:

Feature: [ ] (IFOL1 MLIN1) IFOL1

Specify FEATURE location: (Hide) 580000,5900000

Specify STRIKE: [0] 30

FIELDLOG retains information for a station in data buffers until a new station is added,

at which time it saves the data to text files located in the data directory. STORE will also save a station's data in this manner.

If ADD is aborted, by pressing Cntl-C, midway through data input to a database, those data are rejected by FIELDLOG, and are cleared from the buffers and screen when the next FIELDLOG command is invoked. It is very dangerous to abort ADD with Cntl-C when ADD is saving data from the buffers to text files, as data would most probably be lost.

5.3.1 Store

STORE saves a station's data to a text file in the data directory. Data for one station are retained by FIELDLOG until a new station is ADDed or STOREd. The data are saved to the data directory and the buffers containing the data are cleared. When STORE saves the data, it lists the names of the databases in which data are present and currently being saved. In the course of normal operations, it is generally unnecessary to STORE, as data are automatically stored at every new station and as part of most FIELDLOG commands. STORE should never be aborted with Cntl-C as this would interrupt the saving process and result in the loss of data.

5.3.2 Retrieve

RETRIEVE allows ADD-like editing of station data. The user gives a station number and RETRIEVE finds the station data, presenting them to the user in sequences of prompts, one database at a time. Like ADD, RETRIEVE scrolls through a database's fields, displays the current field data in square brackets [ ] and allows the user to overwrite these data. Pressing ENTER will retain the old data in a field. A typical example of a

RETRIEVE prompt with old data and a new entry is:

Rock Type [BASALT] ( ) : DACITE

When it is initiated, RETRIEVE first requires the user to specify a station number, by displaying the prompt:

Station No. [ ] ( ) : 0001

It then confirms the response, with 'No' as the default if ENTER is pressed :

Station No. 0001 Retrieve [N] (Y/N) ? _

If 'Yes' is confirmed, FIELDLOG searches for the station data in its internal buffer and then in the databases. If the station is buffered, editing will begin instantly. FIELDLOG asks for the name of the database to edit and presents an list from which it can be selected. For the example in Appendix 3, this prompt would be:

Edit database: (STATI OUTCR STRUC COMMO ALTER PHOTO SAMPLE) _

If the requested station is not currently buffered, FIELDLOG will extract the data for that station from the databases. To extract database data, FIELDLOG will first save any buffered data, then proceed to search the databases for the required data, and write them to text files. The data are then read into the data buffers, for RETRIEVE to edit. Editing occurs in ADD-like fashion, with databases edited one at a time and fields within a database displayed sequentially for revision. MEMO fields cannot be edited with RETRIEVE, and are bypassed in the prompting sequence, if encountered. Use FIELDLOG to edit MEMO fields.

Using RETRIEVE to edit data not in the current data buffers is usually a tedious and time-consuming process and should be avoided whenever possible. Generally, RETRIEVE should be used only to modify currently buffered stations, and only data that are not

displayed on the map. MODIFY should be used to modify all data displayed on the map.

RETRIEVE must not be aborted with Cntl-C when it is loading data retrieved from the databases, as this will result in the loss or scrambling of data for that station. Cntl-C will safely abort RETRIEVE otherwise.

5.3.3 Modify

MODIFY allows the user to change symbols and text in the drawing, either individually or globally. These changes are also relayed to the database. MODIFY first prompts the user to select the map data which are to be changed:

select objects : _

For more information on how to select from this prompt, see the *AutoCAD* reference manual. If no data are selected, MODIFY returns to the *AutoCAD* command line. If data are selected, the user specifies which are to be changed:

Change from : _

If the user responds by pressing ENTER, all the data will be changed. The user can also answer this prompt with a mask which will cause only entities satisfying the mask to be changed. The mask can contain the wild character '*'. For example, the mask *,3d,* could be used to change all text with an embedded ',3d,'. MODIFY recognizes data satisfying the mask and will alter them to the specified value (see Appendix 6 for more information on masking). The user must first specify this new value:

Change to : _

MODIFY treats the '*' as a regular asterisk in the *Change to:* value. Also, only the first non-wild characters in the mask will be changed to the new value. For example, the mask

,3d,,7c,* with a new value of '10b' would cause the text '1a,3d,5e,7c,8a' to be changed to '1a,10b,5e,7c,8a'. Only the first non-wild characters get changed to the new value. If no new value is entered in response to the *Change to:* prompt, MODIFY makes no changes to the drawing. Lastly, MODIFY asks for the layer on which to put changed data:

Layer name : _

If no layer name is given, the changed entities retain their original layering. It is dangerous not to specify a layer name, as most entities are placed on layers coinciding with their names (eg. all IFOL1's are on an IFOL1 layer). Changing such entities to another value but leaving them on the previous layer could affect visual data analysis, as layers of a certain name would not necessarily possess all the data with that name (eg. changing IFOL1 to IFOL2, but leaving it on the IFOL1 layer).

The *Layer name:* prompt does not recognize wild characters.

MODIFYing a station number on the map will cause FIELDLOG to search all the databases for that number and change it to the new value in all the databases during updating. If a station number has been mistakenly repeated on a map and then MODIFied to the proper number, all occurrences of the specified number would be changed by FIELDLOG to the new value, including the original, correct entries. It is important to take great care when adding station numbers to the map.

Cntl-C can be used to abort MODIFY. If MODIFY is aborted in the middle of changing data, only a portion of the data will have been changed.

5.3.4 Erase

ERASE deletes entities from the drawing and also from the database. A record of each entity deletion is stored in a text file in the data directory. FIELDLOG uses this record to UPDATE the database and empty the specified fields. ERASE first asks the user to select entities for deletion with the prompt:

select objects : _

Drawing entities can be selected in a variety of ways from this prompt (see the *AutoCAD* reference manual). The user can then apply a mask to the selected entities in order to erase only a subset of the selections:

Containing : _

The mask can contain the wild character '*'. For example, the mask *FRAC* will erase all entities with 'FRAC' in their name. If no wild character is present, only entities with names exactly equal to the mask will be ERASEd (eg. the mask FRAC will erase all entities whose exact name is 'FRAC'). Pressing ENTER without specifying a mask will ERASE all the selected entities.

ERASEd entities become blank fields in the database. The links from the database to the map for these entities and fields are destroyed and cannot be recovered. This means that once entities are ERASEd, they cannot be recovered to the map, but must be inputted again. ERASE replaces the contents of fields whose corresponding drawing entity has been ERASEd with an empty value. For this reason, ERASE cannot be used to delete rows from the database, as only specific fields are affected by the ERASE process. To delete rows, first ensure that all map data from the row are ERASEd, creating blank fields in the row for those entries. Next, DELete the row in FIELDLOG and restructure the database to purge the deleted row.

Cntl-C can be used to abort ERASE. **ERASE should not be invoked from *AutoCAD*'s pull-down menu** as it can cause erratic problems in the drawing editor.

5.3.5 Hidedata

HIDEDATA is similar to ERASE, except that data that are hidden are removed only from the drawing and not from the databases. In this way, congested maps can be simplified without eliminating otherwise important data from the databases. When data are hidden, FIELDLOG removes the links to the database from those data. Consequently, hidden data cannot be unhidden and redisplayed on the map. FIELDLOG designates hidden data in the status line of the database viewer. HIDEDATA displays to the user the same *select objects:* and *Containing:* prompts as ERASE. Refer to ERASE (Section 5.3.4) for an explanation of their use.

5.3.6 Size

SIZE determines the height of newly ADDed symbols and text on the map and adjusts the size of existing map data (symbols and text only). SIZE first prompts for new symbol and text heights, showing the current values in square brackets:

Symbol size : [5] _

Text size : [12] _

Pressing ENTER at either prompt will retain the previous values.

The values entered for symbol and text size are arbitrary, and depend on the coordinate system used, the original height of the symbol or letter, and the final output scale of the drawing. Users must determine, by trial and error, values appropriate for their drawing. The following are suggested as initial values, and have been derived by using a UTM-based

map, the GEOSHAPE symbol file (provided with FIELDLOG) and standard *AutoCAD* text fonts:

1:20,000 scale - Text = 25 and Symbol = 14

1:50,000 scale - Text = 70 and Symbol = 30

After text and symbol sizes have been selected, SIZE displays the following prompt to select existing map data for resizing:

select objects : _

Refer to the *AutoCAD* reference manual for information about selecting map entities with the *select objects*: prompt. SIZE operates only on symbol and text data, even if other types of entities (eg. lines) are selected. If no selections are made, SIZE stores the symbol and text size values and exits to the *AutoCAD* command line.

If many drawing entities have been selected for resizing, SIZE allows the user to filter this selection with the prompt:

Containing : _

The user can respond with a mixture of the wild character '*' and alphanumeric characters to form a mask which filters the selected entities. Only entities coinciding with the mask will be resized. For example, the response *FRAC* to this prompt would cause resizing of all symbol and text entities with FRAC embedded in their name. A response of FRAC would cause all symbols and text named FRAC to be resized. Refer to Appendix 6 for more information on masking.

If ENTER is pressed in reply to the '*Containing:* ' prompt, all selected entities will be resized.

5.3.7 Rotate

ROTATE changes the angle of rotation of text and symbol entities and records the new rotation angle in a text file which updates the database. Some symbol fields require that their rotation angle be stored in a companion field in the same database (eg. the structural FEATURE field records its angles in the STRIKE field in the STRUCtural database). ROTATE records these changes in a text file which FIELDLOG later uses to correct the database. Text entries are simply rotated in the drawing and this information is not relayed to the database. ROTATE first prompts the user to select entities for rotation with:

select objects : _

See the *AutoCAD* reference manual for more information on selecting map data from this prompt. If no entities are selected, ROTATE returns to the *AutoCAD* command line.

A valid entity selection causes ROTATE to display the following prompt:

Containing : _

The user can enter a mask to filter the selected data, so that only entities matching the mask will be rotated. The mask can contain the wild character '*'. If ENTER is pressed in reply to the *Containing:* prompt, all selected entities will be rotated.

ROTATE then queries for the new rotation angle:

Angle : _

The angle can be expressed as a numeric value, or a pointing device (puck or mouse) can be used to choose two points to illustrate the angle. It is important to remember that 0° is the vertical direction and that angles increase clockwise. Therefore, a rotation angle of 90° would cause a text entity to be oriented horizontally on the map.

5.3.8 FIELDLOG

Typing FIELDLOG at the *AutoCAD* command line will run the FIELDLOG program. This allows the user to view data and change database definitions without leaving *AutoCAD*. Any buffered station data will be saved prior to FIELDLOG's execution. When the FIELDLOG program is exited, FIELDLOG's *AutoLISP* commands and the database definitions will be reloaded, in order to accommodate any changes in the database structures (eg. the addition or deletion of fields). If users have trouble invoking FIELDLOG from the *AutoCAD* command prompt, they should ensure that the ACAD.PGP file has been properly modified. These changes are discussed in the installation instructions (Section 2.4).

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APPENDIX 1. MAINTAINING MULTIPLE DATA DIRECTORIES

It is often necessary to keep data separated. Working with numerous projects or non-adjacent map areas would generally require the segregation of data. This segregation can be accomplished by creating different directories in DOS for each set of data and adjusting the FIELDDATA environment variable accordingly, prior to every FIELDLOG session. The FIELDDATA environment variable stores the name of the current data directory. FIELDLOG reads this name and directs its actions to the data in that directory. **FIELDDATA must be initialized before FIELDLOG will function.** FIELDDATA can be set by typing the following at the DOS command prompt:

SET FIELDDATA = C:*yourdatadirectory*

If the user is working with multiple data directories and simultaneously maintaining *AutoCAD* maps, **it is important to consistently use the same map with the same data directory.** Considerable harm can be done to the data if data directories and drawings are freely mixed. Not only would data be recorded in an incorrect database, but some of the links between the drawings and databases could be damaged, resulting in an inconsistency between them. The user would then be unable to edit the drawing from the map.

APPENDIX 2. MAINTAINING MULTIPLE MAPS FROM A DATA DIRECTORY

FIELDLOG lends itself quite easily to the maintenance of several maps from one data set, with only one exception. Once the decision to keep data on several maps has been made and initiated, and data are resident on more than one map, the maps cannot be merged. Merging maps after the addition of data to them will change the links FIELDLOG requires for the map-database interface. Map edits will no longer be transferred properly to the database in this case.

To generate a composite map from several FIELDLOG-maintained maps, copy the maps into a different directory and use *AutoCAD* to join them. FIELDLOG commands should not be used to edit merged maps, as they might inadvertently damage database data. Use *AutoCAD*'s many cartographic tools to manipulate the composite map.

APPENDIX 3. SAMPLE DATABASE DEFINITIONS

The following is meant to provide an illustration of the database definitions necessary for a FIELDLOG geological mapping project. This setup comprises 7 databases: STATIon, OUTCROp, STRUCture, COMMOdity, ALTERation, SAMPLe, and PHOTO.

DBASE	FIELDNAME	TYPE	L	D	D	PROMPT	KEYWORD	N	D	LAYER
*STATI	STATIONNO	INT	5	0	N	Station No:		N	Y	STNO
STATI	AIRPHOTO	TEXT	15	0	Y	Airphoto:		N	N	
STATI	DATE	DATE	8	0	Y	Date:		N	N	
STATI	COMMENT	MEMO	80	0	N	Statn Memo:		Y	N	
OUTCR	LOCATION	PNT	7	0	N	Location:		N	N	
OUTCR	LEGEND	TEXT	20	0	N	Legend:		N	Y	LEGEND
OUTCR	COMMENT	MEMO	80	0	N	Outcr Memo:		Y	N	
◆STRUC	FEATURE	SYM	7	0	N	Feature:	IFOL1	Y	Y	TAG
STRUC	STRIKE	INT	3	0	N	Strike:		Y	N	
STRUC	DIP	INT	2	0	N	Dip:		Y	Y	LASTTAG
STRUC	ROCKTYPE	TEXT	15	0	N	Rocktype:	DCTE	Y	N	
COMMO	MINERAL	TEXT	4	0	N	Mineral:	Py Apy	Y	Y	ECHO
COMMO	ROCKTYPE	TEXT	15	0	N	Rocktyp:	ANDS	Y	N	
COMMO	PERCENT	INT	2	0	N	Percentage:		Y	N	
ALTER	ALTERTION	TEXT	7	0	N	Altertion:	Ser Ch	Y	Y	ECHO
ALTER	ROCKTYPE	TEXT	15	0	N	Rocktype:	BSLT	Y	N	
ALTER	INTENSITY	TEXT	1	0	N	Intensity:	W M S	Y	N	
SAMPL	SPECIMEN	PNT	5	0	N	Specimen:		Y	N	
SAMPL	STRIKE	INT	3	0	N	Strike:		Y	N	
SAMPL	DIP	INT	2	0	N	Dip:		Y	N	
SAMPL	REASON	MEMO	80	0	N	Reason:		Y	N	
PHOTO	PHOTONUM	INT	5	0	N	Photonum:		Y	N	
PHOTO	COMMENT	TEXT	80	0	N	Comment:		Y	N	

The FUNCTION column has been omitted from this table, but does appear on screen. Refer to the FUNCTION description (Section 3.3.8) for more information.

APPENDIX 4. FILES CREATED BY FIELDLOG

When FIELDLOG restructures database definitions, it forms various files. Each database name, which can be at most 5 characters in length, can have the following files associated with it:

dbasename.DBF	The actual database containing data.
dbasename.NDX	Aan index file based on station numbers.
*dbasename*ID.NDX	An index file based on the ID field.
dbasename.DBT	A file containing memo fields for the database.
*dbasename*BAK.DBF	A backup database file, created before last restructuring.
*dbasename*BAK.DBT	A backup memo file, created before last restructuring.
dbasename.DAT	A text file from *AutoCAD* containing data to append to the database.
dbasename.FND	A text file created with RETRIEVE in *AutoCAD* containing a station's data.

In addition, FIELDLOG creates the following files for internal use:

FIELDLOG.DBF	The current database definitions. These should only be edited with FIELDLOG, as other database managers could damage the structure of the file.
FIELDLOG.NDX	An index file for the database definitions.
FIELDLOG.LST	A text file with database definitions for FIELDLOG *AutoLISP* commands.
TEMPLOG.DBF	A working copy of database definitions.
TEMPLOG.NDX	A working copy of index for database definitions.
GEOID.DBF	A linkage database, containing *AutoCAD* and database linkage

	data.
ID.NDX	An index file for the linkage database.
REC.NDX	A second index file for the linkage database.
LASTDWG.LST	A text file containing the names of drawings edited.
NEXTDWG.LST	A text file containing the next drawing number available for the data.
MOD.DAT	A text file containing a record of map edits, for updating the databases. Edits from the MODIFY, ERASE, HIDEDATA and ROTATE commands are placed in this file.

APPENDIX 5. FIELDLOG *AutoLISP* COMMAND SUMMARY

ADD	Appends data to the map and the database. The user selects the database into which data will be added, and ADD sequentially presents the fields for data input. ADD also saves the last station's data to text files when a new station is created.
ERASE	Removes data from the map and clears the field containing the data in the database. The user selects the data using the puck or mouse. Global deletes are possible. Only symbols and text are affected.
FIELDLOG	Runs the FIELDLOG program without exiting *AutoCAD*. Allows database data to be viewed, edited and updated, and the database structure to be altered. Returns to *AutoCAD* when exited.
HIDEDATA	Similar to ERASE, except that database data are left intact.
MODIFY	Changes map data and database fields to new values. The user points to the data with the puck or mouse and enters a new value. Only symbols and text are modified. Global changes are possible.
RETRIEVE	Allows field-by-field editing of data for a station. It is similar to ADD's data entry. The user names a station to edit, and, if this station is not currently resident in the data buffers, the

station data are retrieved from the databases. This is a very tedious process. It is recommended that RETRIEVE be used mostly for currently buffered data. MODIFY is the preferred editing tool.

ROTATE — Rotates map data. The angle will be recorded in the database if required. A numeric value is entered, or two points are chosen with a puck or mouse to give the angle. 0° is vertical and angles increase clockwise. Only symbols and text can be rotated.

SIZE — Sets default symbol and text heights, and changes the height of existing data. Global changes are possible.

STORE — Saves the data. The current station is written to text files, which are used to update the databases.

FIELDLOG replaces the following *AutoCAD* commands with its own: ROTATE, ERASE, END, SAVE, QUIT. These commands operate in the same manner and fulfill the same purposes, unless documented otherwise. **The ERASE command should not be used from *AutoCAD*'s pull-down menu.**

APPENDIX 6. USING MASKS IN MODIFY, ERASE, HIDEDATA, ROTATE AND SIZE

The FIELDLOG *AutoLISP* commands MODIFY, ERASE, HIDEDATA, ROTATE and SIZE provide the user with the ability to filter a selection of data chosen interactively from the display. A *mask* is created by the user and used by the FIELDLOG command as a basis of comparison with the selected data. Only data matching the mask will be affected by the command. The asterisk is used as a wild character, standing for all characters in a symbol name or text entity. The following are examples of masks.

(1) The mask * implies no filtration of data, as the complete selection set is acceptable.

(2) The mask 'XX' chooses symbols and text exactly equal to 'XX'.

(3) *XX, however, filters a selection set for those symbols and text ending with 'XX' (eg. XX, aXX, aXXaXXXX, etc.).

(4) Wild characters can be used more than once in a mask, to specify more complex situations. For example, *XX* will accept only symbol names and text that contain the sequence 'XX' anywhere within them (eg. XX, aXXa, aXXaXXa, etc.).

(5) The mask *XX*XX* will accept only symbol names and text with 'XX' embedded twice anywhere within them (eg. aXXaXXa, XXaXX, aXXXX, XXXXa, aXXaXXaXXXX etc.).

APPENDIX 7. PLACING LITHOLOGIES ON A MAP

Most surface geological mapping includes the collection of lithology codes, which are placed on a map and in a database, and which form the basis for a map legend and which link individual polygonal areas on the map with a colour. As the geology of an area is better understood over the course of a study and the geological interpretation changes, so does the assignment of the lithology codes. What may have been classified as '2b' at one stage might be later reclassified as '4c'. In order to make these changes globally, the lithological codes at a station must be entered somewhat differently than convention has previously dictated. Previously, a station's lithological coding might have resembled '1abc,2bd,3f', making it difficult to make global changes. However, if each code is entered separately as a unit, delimited by commas (eg. '1a,1b,1c,2b,2d,3f'), global changes are possible. While this notation does take up more map and database space, it is most suitable for carrying out global changes. In this format, the user can search for '2b' and replace it with any other code (eg. '4c'). MODIFY in *AutoCAD* and most database managers will perform this global change.

Using MODIFY in *AutoCAD* to change lithology text requires four passes over the data, using four different masks, as for example:

'2b'	for text equal to '2b' (eg. '2b').
'2b,*'	for text beginning with '2b' (eg. '2b,3c,4c').
'*,2b,*'	for text with '2b' embedded (eg. '1a,2b,3c').
'*,2b'	for text ending in '2b' (eg. '1a,2b').

For this lithology coding format, the placement of commas in a mask is crucial to the distinction between, for example, a '2b' and a'12b'. A mask containing only '*2b*' would change '2b' as well as '12b', since both satisfy the masking criteria. This notation for lithological data is also suitable for users using the database entry mode, as most database

managers provide techniques for searching and replacing well-defined portions of text fields.

APPENDIX 8. GEOSHAPE.SHX - Geological Symbols

IFOL1, IFOL2, IFOL3: Schistosity (planar preferred alignment of minerals), inclined: S_1, S_2, S_3

VFOL1, VFOL2, VFOL3: Schistosity, vertical: S_1, S_2, S_3

HFOL1, HFOL2, HFOL3: Schistosity, horizontal: S_1, S_2, S_3

FOL1, FOL2, FOL3: Schistosity, dip unknown: S_1, S_2, S_3

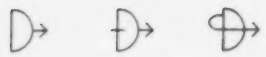
IBED, VBED, HBED: Bedding (S), top unknown; (inclined, vertical, horizontal)

IOBED, VOBED, OOBED: Bedding, top (arrow) from criteria other than grain gradation or crossbedding (e.g. dewatering phenomena); inclined, vertical, overturned

ICBED, VCBED, OCBED: Bedding, top (arrow) from crossbedding; (inclined, vertical, overturned)

IFBED, VFBED, OFBED: Bedding, top (arrow); for all top determinations in lava flows other than by pillow shapes; (inclined, vertical, overturned)

IGBED, VGBED, OGBED: Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned)



IFTOPS, VFTOPS, OFTOPS: Tops (arrow) in lava flow from pillow shape and packing (inclined, vertical, overturned)

IGNS, VGNS, HGNS: Gneissosity (inclined, vertical, horizontal)

IJNT, VJNT, HJNT: Jointing (inclined, vertical, horizontal)

IFRAC, VFRAC, HFRAC: Fracture orientation (inclined, vertical, horizontal)

ICLV1, ICLV2, ICLV3: Cleavage, inclined (S_1, S_2, S_3)

VCLV1, VCLV2, VCLV3: Cleavage, vertical (S_1, S_2, S_3)

HCLV1, HCLV2, HCLV3: Cleavage, horizontal (S_1, S_2, S_3)

IDIKE, VDIKE, HDIKE: Dike, inclined, vertical, horizontal

CCLV: Crenulation cleavage, inclined

MLIN1, MLIN2, MLIN3: Mineral lineation (linear alignment of minerals on the cleavage plane), trend and plunge, on first, second, third cleavage plane.

ELIN1, ELIN2, ELIN3: Shape elongation (lineation defined by the long axis of pebbles, varioles, volcanic clasts, mineral aggregates, etc.), trend and plunge, on first, second, third cleavage plane.

VLINS, VLINI, VLINM: Vertical lineation (shape, intersection, mineral).

VLINCI, VLINSS, SSLIN: Vertical lineation (crenulation intersection, slicken striae); Slicken striae lineation, trend and plunge.

CLIN: Crenulation lineation.

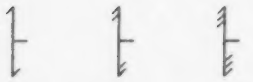
INTER: Intersection lineation.

YOUNG: Tops (general symbol for regional scale maps).

PALEO: Direction of paleocurrent.

GLAC: Glacial striae; (direction of ice movement known from nailhead, or wedge striae).

SHR, SHRR, SHRL: Shear zone (Sense unknown, right-handed, left-handed).

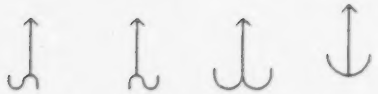


ISFOL1, ISFOL2, ISFOL3: Inclined shear foliation (on first, second, third shear plane); symbol used in conjunction with SHR symbols.

SLIN1, SLIN2, SLIN3: Shear lineation (linear alignment of minerals on the cleavage plane), trend and plunge, on first, second, third shear plane; symbol used in conjunction with ISFOL or VSFOL symbols.

VSFOL1, VSFOL2, VSFOL3: Vertical shear foliation (on first, second, third shear plane); symbol used in conjunction with SHR symbols.

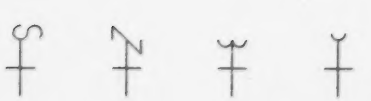
NDOWN, RDOWN: Ball shows downthrown side (normal and reverse).



SFOLD, ZFOLD, WFOLD, UFOLD: Plunge of fold axes (S-fold, Z-fold, W-fold, U-fold).

IAXPL, VAXPL, HAXPL: Strike and dip of axial plane (inclined, vertical, horizontal); symbol used in conjunction with SFOLD, ZFOLD, WFOLD, UFOLD symbols.

ISFOLD, IZFOLD, IWFOLD, IUFOLD: Strike and dip of inclined enveloping surface to S-fold, Z-fold, W-fold, U-fold; symbol used in conjunction with SFOLD, ZFOLD, WFOLD, UFOLD symbols.



VSFOLD, VZFOLD, VWFOLD, VUFOLD: Strike of vertical enveloping surface to S-fold, Z-fold, W-fold, U-fold; symbol used in conjunction with SFOLD, ZFOLD, WFOLD, UFOLD symbols.

IZKBAND, ISKBAND, VZKBAND, VSKBAND: Strike and dip of inclined (I) and vertical (V) kink bands.

KLIN1, KLIN2, KLIN3: Trend and plunge of kink fold axis (first, second, third fold axis)

VEIN, IVEIN, VVEIN, HVEIN: Strike and dip of vein (dip unknown, inclined, vertical, horizontal).

OUTCROP: Small outcrop symbol

BOX: Box symbol.

TRIANGLE: Triangle symbol.

DIAMOND: Diamond symbol.

ASTERISK: Asterisk symbol.

CIRCLE: Circle symbol.

SWAMP: Swamp symbol.

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